

INSTRUCTOR LESSON PLAN

Lesson Title: INCORE NEUTRON MONITORING SYSTEM		Date: March 9, 1986
Program: R206-P (B&W)		Author: Gage
p 10.2-1	<p>9.0 OBJECTIVES</p> <p>9.1 OUTPUTS</p> <ol style="list-style-type: none"> 1. Axial flux 2. Radial flux (quadrant power tilt) 3. Fuel assembly exit temp 4. Core differential press. <p>9.2 SELF-POWERED NEUTRON DETECTOR (SNPD)</p> <p>A. Operation</p> <p><i>6562</i> assemblies (7detectors/assembly)--- <i>455</i> 434 total activation of Rh (subsequent B decay)</p> <p>Rh insulated from elec. ground---B decay represents charge deficiency \propto # n interactions</p> <p>Rh material connected---measure charge deficiency through current meter</p> <p>No external power source necessary</p> <p>B. Response time</p> <p>proportional to Rh-104 decay to Palladium effected by 2 half-lives (decay chains)</p> <p>93% --- 42 sec 7% --- 4.4 min</p> <p>important during changing flux levels after step change in power level: 5 min to obtain new equil. value for output precludes use in RPS (too slow of response)</p> <p>9.3 INSTALLATION</p> <p>A. Rx vessel</p> <p>physically pushed through conduit from instrument tank to vessel bottom</p> <p>guide tubes (inside Rx vessel)--- mech. interface between conduit & fuel assembly guide tube</p> <p>RCS pressure boundary</p> <p>B. Closure assembly</p> <p>plug</p>	Reviewed By:
Fig. 10.2-1		
Fig. 10.2-2		
Fig. 10.2-3		
Fig. 10.2-5		
Fig. 10.2-7		

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Notes	Lesson Plan (Continuation Sheet)
	<p>O rings (Ag plated) surround seal assembly as nut ring is tightened, o rings are deformed to form the seal</p> <p>nut ring</p> <p>C. Instrument tank refueling: incores withdrawn (25' inside conduit) little exposure (detector still inside conduit)</p> <p>replacement: requires shielding can flood tank (from spent fuel system)</p>
Fig. 10.2-4	<p>9.4 ARRANGEMENT</p> <p>assemblies inserted in fuel assembly inst. tubes detectors positioned between fuel assembly spacer grids</p>
Fig. 10.2-6	<p>A. Each assembly (Inconel sheath):</p> <p>7 detectors background detector TC (chromel - alumel) Al_2O_3 insulation</p> <p>B. Detector corrections (done by computer)</p> <ol style="list-style-type: none"> 1. sensitivity factor (manufacture error) provided by manufacture (X-ray) 2. background (gamma reaction in detector & leadwi 3. Burnup (Rh depletion) 4. leakage (insulation resistance change)
Fig. 10.2-8	<p>C. Detector outputs</p> <p>recorder --- displays selected incore levels cal. pot. -- compensates recorder input detector burnup</p> <ol style="list-style-type: none"> 1. core exit temperature 2. core differential pressure central spacer tube open at top (RCS press) open to outside of outer sheath (bottom) 3. neutron flux --- computer calculations <p>F</p>

Notes

Lesson Plan (Continuation Sheet)

F_Q^N --- nuclear heat flux hot channel factor

F_H^N -- nuclear enthalpy rise hot channel factor

* offset --- axial flux distribution

* quadrant power tilt --- radial flux distribution

9.5 MINIMUM DETECTOR REQUIREMENTS

Fig. 10.2-9

A. Axial Power Imbalance (offset)

~~1. 75% detectors operable in each quadrant~~

2. 3 assemblies with 3 detectors per assembly:

one detector in upper core half
one detector in lower cor half
one detector at core mid-plane

3. Axial planes in each core half MUST be symmetrical about core mid-plane

4. the 3 detectors shall not have radial symmetry

Fig 10.2-10

B. Quadrant Power Tilt (radial flux)

1. 75% detectors operable in each quadrant

2. 2 sets of 4 detectors shall lie in each half
(8 detectros / half)

3. Each set of detectors shall lie in the same axial plane.

The 2 sets in each half MAY lie in the same axial plane

4. Detectors in the same plane shall have quarter core radial symmetry

$$QPT = 100 \left(\frac{\text{power in a core quad.}}{\text{ave. power in all quad.}} - 1 \right)$$